

Tonight on NOVA, we will explore the building blocks of our world as we know it. According to today's most accepted theory, the universe is made up of 70% dark energy, 25% dark matter, and 5% normal matter. In this episode, we will delve into the mysteries of the normal matter – what humans, trees, the earth, and animals are composed of.

Dr. Seuss:

Five percent of the universe is made up of normal matter, the kind of stuff that we have studied extensively. We have organized all of this information into a chart called the Standard Model.

The world around us, you and I, are made of baryonic matter, which is made of atoms. Atoms are extremely small and within each atom there is a nucleus and an electron cloud surrounding the core. Electrons are negatively charged point particles that zoom around really, really fast. In the nucleus there are protons, which are positively charged, and neutrons, which are neutral (or no charge). These protons and neutrons are made of smaller particles called quarks.

Dr. Cyclotron:

There are six members of the quark family: three with  $+\frac{2}{3}$ <sup>rd</sup>s charge – the Up, Charm, Top, Down, Strange, and Bottom. Charm and Strange are exotic, but can be created naturally in cosmic rays. The Top and Bottom are so rare that we only see them in the laboratory. Decay turns most of them into Up and Down.

When quarks cooperate, they act like Mariachis. A lone quark, like a lone Mariachi, never happens – you just never see one. In twos and threes they excel, and they form very stable and successful groups. But when groups of four get together, like any band, the drama is too much. One of them gets into trouble with the law, or finds Yoko Ono and breaks up the band, and it just doesn't work out.

What about electrons you say? They're a kind of particle called leptons, and they're more like brothers. The electron we know and love, is the baby, followed in age and size by the muon, and then the tau. The tau has the greatest mass by far, and while these heavy leptons can be created, they do eventually decay back into electrons. And that is our family of regular matter.